PRE-ATIVITY AND POST-ACTIVITY FLEXIBILITY PRACTICES OF COLLEGIATE DIVISION I VOLLEYBALL PROGRAMS

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ADAM BOTTONE

ADVISOR – DR. LARRY JUDGE

BALL STATE UNIVERSITY

MUNCIE, INDIANA

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ABSTRACT

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Student: Adam Bottone

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The focus of this study was to determine if NCAA Division I women's volleyball programs were in compliance with suggested current pre- and post-activity stretching protocols. The study looked at certification, size of school, win-loss records, and years coaching to determine if there was a link to pre- and post-activity stretching practices of NCAA Division I women's volleyball programs. A survey was sent to 291 Division I women's volleyball programs; 56 (23 males & 33 females) coaches, assistant coaches, strength and conditioning coaches, or assistant strength and conditioning coaches responded. A questionnaire designed to gather demographic, professional, and educational information, as well as specific pre- and post- activity practices, were distributed via email to NCAA Division I women's collegiate volleyball coaches. Through the use of a one way ANOVA test, it was concluded that based on school size (BCS school vs. Mid Major school), we could not reasonably determine a significant difference in pre-activity static stretching due to an overlapping confidence interval of the two types of schools. Some results seemed to conflict with current suggested practices of pre-activity flexibility. Of the 29 programs that indicated they used static stretching, 17 had winning records and 12 had losing records. Current research indicates that a dynamic stretch, not a static stretch, is more beneficial to athletes prior to activity (Faigenbaum et al., 2006; Herda et al., 2008; Kovacs, 2006; McMillian et al., 2006; Samuel et al., 2008; Yessis, 2006; Young and Elliott, 2001). Coaching certification appeared to have little to no supporting data which correlated with current suggested recommendations for pre-activity stretching protocols as both coaching specific certified coaches and certified strength and conditioning coaches had their athletes perform static stretching prior to activity. In addition, years coaching only resulted in the data that

showed the more years coaching, the less likely the head coach was to conduct pre-activity stretching. In each age category, there were coaches who allowed static stretching prior to activity which again is against current suggested practices of conducting a dynamic stretch prior to activity. Results conclude that coaches of all demographics appear out of compliance with current research; further research needs to be conducted to determine why this is.

Introduction

Explosive movements such as jumping and quick lateral movement are essential to the sport of volleyball. Being able to appropriately prepare the body and more specifically the muscles to perform at optimal levels in practice and in competition is the priority. Pre-activity flexibility should be an important part of every athletic program; however, the debate still remains what type of warm-up stretching combination is appropriate (Beedle, Leydig and Carnucci, 2007). While past research tended to favor static stretching as the appropriate type of pre-activity flexibility to be performed, more recent research supports the benefits of performing dynamic stretching as the appropriate type of pre-activity flexibility to be used.

Review of Literature

Types of Stretching

Proprioceptive neuromuscular facilitation stretching (PNF), ballistic stretching, static stretching, and dynamic stretching are the prominent types of stretching that most athletes, coaches and athletic trainers currently use. All of these types of stretching are unique in their own right; they are performed in a different manner, but with the same expected result of reducing risk of injury and improving range of motion. The following section explains each of these types of stretching in greater detail.

PNF stretching techniques are commonly used in the athletic and clinical environments to enhance both active and passive range of motion (Sharman and

Cresswell, 2006). PNF is considered the most effective stretching technique when the aim is to increase the range of motion, specifically in respect to short-term changes in range of motion (Sharman and Cresswell, 2006). Originally developed in the 1950s PNF stretching was used as a rehabilitation technique for stroke patients; today, athletic trainers and therapists will use PNF techniques to increase range of motion and improve strength although it does not increase core body temperature (Mann and Whedon, 2001). While PNF stretching is a good program for athletes to use for increasing range of motion and decreasing muscle soreness, it can be a very complicated procedure and may not be appropriate on the athletic fields unless the athletes are properly trained on how to administer the techniques properly (Mann and Whedon, 2001).

Static stretching, the most commonly used program of athletes and coaches, requires the holding of a stretch position for a length of time with little or no movement (Mann and Whedon, 2001). When done correctly, a static stretch includes the relaxation and concurrent elongation of the stretch muscle, if performed slowly and accurately, the risk of injury is reduced (Baechle and Earle, 2000). Static stretching should not facilitate excessive tension being on the muscle spindle as this may cause a reduction in the stretch and injury to the muscle (Mann and Whedon, 2001). However, much like PNF stretching, static stretching does little to increase the core body temperature (Mann and Whedon, 2001). Static stretching is best used after activities as a cool down and should consist of static-based cool down exercises as significant gains in range of motion can be achieved (Mann and Whedon, 2001).

Ballistic stretching involves an active muscular effort and uses a bouncing-type movement in which the end position is not held (Baechle and Earle, 2000). Due to the bouncing-type movement, many researchers have concluded that ballistic-type stretching is counterproductive to warm-up exercises because it leads to a firing of the muscle spindle which initiates the stretch reflex, leading to a greater potential for injury (Mann and Whedon, 2001). Because the stretch reflex is activated, the muscle is not allowed to relax which defeats the purpose of stretching (Baechle and Earle, 2000). Unlike static and PNF stretching, ballistic stretching does have the potential to increase the body's core temperature; however, its safety in the athletic arena must be questioned (Mann and Whedon, 2001).

A more common type of stretching is dynamic stretching which allows for flexibility during a sport-specific movement. Although similar to ballistic stretching, dynamic stretching avoids bouncing and includes movements specific to a sport or movement pattern (Baechle and Earle, 2000). Dynamic stretching includes active stretching involving a continuous muscle activity to exceed the static range of motion encountered during the normal full-range-of-motion activities (Yessis, 2006). This type of pre-activity flexibility is best done prior to the sport activity as it helps the athlete to prepare for the competition by allowing him or her to increase sport-specific flexibility and it increases core body temperature (Baechle and Earle, 2000). A dynamic stretching program can be fully accomplished in a 10 minute period and can conform to any available space (Baechle and Earle, 2000).

Ideally an athlete wants to raise his or her internal core temperature bringing out performance enhancing physiological changes as well as being an integral part of the warm-up (Swanson, 2006). Traditionally, athletes have been encouraged to use pre-activity static stretching prior to activity to help increase range of motion about a joint (Santana, 2004) and to help prevent injuries (Schilling and Stone, 2000). However, those beliefs have been challenged as more research on this topic has been explored.

Current Warm-up Research Conclusions

In a review article written by Woods, Bishop, and Jones (2007) there is evidence showing that pre-activity flexibility stretching protocols did not deter injury. Many differences within previous research were due to conflicting definitions of stretching and warm-up (Woods, Bishop, and Jones, 2007). The pre-activity flexibility is intended to perform two major functions: 1. Improve a muscle's dynamics so that it is less inclined to injury and 2. Prepare the athlete for the demands of exercise where as stretching results in an elongation of soft tissues and muscles (Woods, Bishop, and Jones, 2007). This review suggests that warm-ups are beneficial because they have shown to increase the speed and force of muscle contractions and also produce an increase in muscle temperature. It also explains that stretching has benefits as well. For example, performing three 30-second repetitions of a static stretch have been reported lead to muscle lengthening which may be maintained for at least 24 hours (Woods, Bishop, and Jones, 2007). Woods, Bishop and Jones (2007) suggest that future research should focus on isolating the pre-activity flexibility protocol and the stretching protocol to determine the impact of each, individually, on injury. It was realized that because of the conflicting definitions of warm-up and stretching, previous studies had differing results when dealing with stretching and/or warm-up (Woods, Bishop, and Jones, 2007).

It has commonly been the case that prior to a sporting event or practice, an athlete would typically take part in a stretching routine, specifically static stretching. A study conducted by Bandy and Irion (1994) compared the length of applied static stretching on joint range of motion and hamstring flexibility. The results of this study

concluded that a duration of 30 seconds is an effective time of stretching for enhancing the flexibility of hamstring muscles (Brandy and Irion, 1994). Static stretching has been the preferred approach to movement preparation, flexibility training, and injury prevention (Woods, Bishop, and Jones, 2007). Research has indicated that static stretching can be a very safe and effective method of stimulating long-term soft tissues adaptations that increase flexibility (Shrier and Gossel, 2000). The question remains: when should an athlete conduct static stretching and should it be a part of the volleyball warm up routine?

Currently research by McMillian, Moore, Halter, and Taylor (2006) leans towards a dynamic warm-up instead of a static stretch warm-up as the best preparation for explosive activities and that static stretching is best done during post activity cool down to help reduce muscle soreness and improve flexibility (Mann and Whedon, 2001). In the study conducted by McMillian et al. (2006), they compared static and dynamic stretching warm up on the effect of power and agility performance. Researchers had all participants attend a two-part orientation session that included instruction for active participation in both the dynamic and static pre-activity flexibility and practice of three performance measures (the T-drill, 5-step jump and the medicine ball throw for distance). The results of this study showed that subjects scored better after the dynamic pre-activity flexibility versus the static pre-activity flexibility or no warm up at all. These results suggest that a dynamic warm up may offer performance benefits not offered with static stretching or no pre-activity flexibility at all (McMillian et al, 2006).

More results (Samuel, Holcomb, Guadognoli, Rubley, and Wallmann, 2008) support the notion that the old practices of static stretching have less effect than that of a dynamic-type of pre-activity flexibility. Because power is adversely affected by a static warm-up, sports that require maximal power output should not be preceded with acute stretching. Instead it is suggested that athletes perform a whole-body continuous activity followed by dynamic stretching that involves rehearsal of sport-specific movements (Samuel et al., 2008).

A third study that supports the current consensus for stretching was conducted by Herda, Cramer, Ryan, McHugh, and Stout (2008). This study focused on the acute effects of static versus dynamic stretching on Isometric peak torque, electromyography, and mechanomyography of the biceps femoris muscle. The results of this study confirmed from previous studies that static stretching has adverse affects on the performance of athletes in sports that require high levels of force production (Herda et al., 2008). It was also concluded that strength and conditioning professionals should consider incorporating dynamic stretching, rather than static stretching, before performance –related activities to maintain or increase muscle strength and/or power output (Herda et al., 2008).

The focus of a study conducted by Fagienbaum, McFarland, Schwerdtman, Tatamess, Kang, and Hoffman (2006) discussed dynamic pre-activity flexibility protocols with and without a weighted vest, and fitness performance in high school female athletes. The results of this study found the pre-activity flexibility protocols that included dynamic exercises resulted in superior performance on vertical jump and long jump compared to

pre-activity flexibility protocol involving static stretching thus supporting the belief that dynamic stretching prior to activity is more effective (Fagienbaum et al., 2006). It is also stated by the author that the best results came when the athletes combined dynamic pre-activity flexibility while wearing a weighted vest; both long jump and vertical jump were improved significantly (12.5% and 10.1%-13.5% respectably)(Fagienbaum et al., 2006).

There is further evidence that indicates there is a decrease in performance when passive static stretching is done prior to activity because of a potential decrease in neural transmission (Fletcher and Anness, 2007). Three different stretch protocols - active dynamic stretch, static dynamic stretch combined with active dynamic stretch and static passive stretch combined with active dynamic stretch - were performed in a randomized repeated-measures with in subject design (Fletcher and Anness, 2007). The results of this study, conducted with ten men and eight women sprinters recruited from two track and field clubs suggests that sprint performance in trained sprinters seems to be optimized by the use of active dynamic stretch protocols. The inclusion of static dynamic work seems to offer no increased benefit to each athlete's performance beyond that offered by active dynamic work alone (Fletcher and Anness, 2007).

In addition, there is no current evidence that pre-exercise static stretching helps to prevent risk of injury (Kovacs, 2006). Studies performed in the former Soviet Union have shown no correlation with static stretching and athletic performance (Yessis, 2006). When prolonged stretching is done prior to activity, tendons and ligaments can be permanently damaged or deformed and may also decrease joint stability (Yessis, 2006). In an article written by Yessis (2006), active stretching has a very high correlation to

athletic performance. This result is in line with another article written by Kovacs (2006) which supports this ideal. Contrary to the widely held belief that static stretching improves physical performance, numerous studies have demonstrated that traditional static stretching actually decreases performance in activities that require strength, speed and power (Yessis, 2006).

With this in mind, there is evidence that supports chronic stretching, specifically static stretching, done post-activity over a long period of time, will help in the development of flexibility and prevention of injury especially in strength and explosive activities (Stone, Ramsey, Kinser, O'Bryant, Ayers, and Sanda, 2006). Research supports the notion that static stretching when done in long duration and post-activity can be beneficial to an athlete in prevention of injury and increasing flexibility (Kovacs, 2006).

Pre-activity flexibility is critical prior to exercise for several reasons including, but not limited to increasing speed and force of muscle contraction, smoother contractions, increase in muscle temperature and increase blood in flow (Swanson, 2006). When done appropriately, the pre-activity flexibility protocols should cause mild sweating, not cause fatigue, be performed 15 minutes prior to the activity and should be specific to the individual athlete and sport (Woods, Bishop, and Jones, 2007). In addition to these benefits, the premise of pre-activity flexibility is to reduce the instance of injury and prepare the athlete for physically for performance. When using static stretching which is slow and passive, there was no benefit to the athlete and there was no significant reduction in injury prevention (Woods, Bishop, and Jones, 2007). The use of PNF

stretching also did not benefit the performance of the athlete especially when done prior to explosive and strength activities (Vetter, 2007; Woods, Bishop, and Jones, 2007).

A separate study evaluating pre-activity flexibility protocols on 20-meter sprint performance in trained rugby union players also concluded that an active dynamic stretching pre-activity showed significantly faster sprint times compared to static stretching (Fletcher and Jones, 2006). It is clear that the evidence currently supports a dynamic warm up as the preferred method to prepare the body for activity. Dynamic pre-activity flexibility is most effective as a preparation for high speed performance (Little and Williams, 2006) as well as for strength and explosive performance (McMillian, Moore, Hatler, and Taylor, 2006).

In a separate study of 40 high school athletes in a bench press of 85% of their 1RM, it was found that after all warmed up, with some adding static stretching and others not stretching, the non-stretchers exhibited significantly more power and greater lifting velocity (McLellan, 2000). It is clear that the evidence supports dynamic pre-activity flexibility as opposed to the more "traditionally" static stretch. Participating in a warm-up that is activity specific is more beneficial in preparing the body to perform in the manner it was intended for the sport in which the individual is participating.

Current Pre-Activity Warm-Up Research Specifically for Volleyball

Volleyball is a sport that requires quick and powerful movements. Therefore, strength and power are essential to the success of the athlete while performing skill sets in practices or competitions. A review written by Bob O'Conner (2003) entitled,

"Stretching The Truth It Is No Bargin!" explains that as stretching is now being investigated as a pre-activity practice; studies consistently reveal that stretching during the pre-activity decreases the athlete's power by 2% to 8%. In a study conducted by Young and Elliott (2001) subjects jogged for five minutes and were then split into one of four groups; traditional static stretching, PNF stretching, forceful contraction of the muscles but no stretching, and a non-stretching group. The results revealed that the control group (non-stretching) tested the best in jumping for height from a resting position and in a plyometric drop jump (Young and Elliott 2001). A volleyball-specific study was conducted by Saez de Villarreal, Gonzalez-Badillo, and Izquierdo (2007) which focused on the "*Optimal warm-up stimuli of muscle activation to enhance short and long-term acute jumping performance*". The study was to determine the effect of different types of active pre-activity stimuli of muscle activation on explosive jumping performance after short and long recovery periods following warm-up (Saez de Villarreal, Gonzalez-Badillo, and Izquierdo, 2007). The results of this study confirmed that high-intensity dynamic loading, as well as specific volleyball pre-activity protocol brought about the greatest effects on subsequent neuromuscular explosive response (Saez de Villarreal, Gonzalez-Badillo, and Izquierdo, 2007).

The purpose of this study is to determine the pre-activity warm-up/stretching practices of women's collegiate Division I volleyball programs (static, ballistic, proprioceptive neuromuscular facilitation), if any, and when in comparing those results with current research conclusions. This study will determine if current division I

volleyball programs utilize a pre-activity protocol that reflects up-to-date research theories.

METHODS

Experimental Approach to the Problem

Questionnaires designed to gather demographic, professional, and educational information, as well as specific pre- and post- activity practices, were distributed via email to NCAA Division I women's collegiate volleyball coaches in the United States.

Subjects

A total to 291 surveys were distributed to every NCAA Division I volleyball program in the United States. This study was approved by the Institutional Review Board of Ball State University, and each potential participant received an Informed Consent form that explained the potential risks and benefit of his or her involvement. Participants in the study were encouraged to contact the principal investigator of this study to answer any questions or provide clarification prior to signing the Informed Consent form. The demographics of the subject population are given in Table 1.

Experimental Procedures

The authors designed a questionnaire to gather demographic, professional, and educational information, as well as specific pre- and post- activity practices. Once completed, the questionnaire was sent to a panel of 5 National Strength and Conditioning Association certified (C.S.C.S.) strength coaches to ensure that it represented a clear,

precise and accurate survey. These professionals in the athletic field verified that the instrument contained both content-and face-validity.

The first half of the questionnaire (questions 1-12) focused on the participant's personal and professional information, whereas the second half (questions 13-33) dealt with the pre- and post- activity practices used with the volleyball players at each institution. The questionnaires were distributed via email to 291 division I programs and the recipients were asked to return the questionnaire within 7 days of receiving them. Non-responders were e-mailed a follow-up questionnaire to increase response rate. Of the 291questionnaires distributed 56 were returned (19.4% return rate) and these represent the subject pool for this study. Upon receiving the completed questionnaires, the individual data was coded and entered into an excel spread-sheet.

Statistical Analysis

The data was examined by computing counts, frequencies, and means where applicable. The alpha level of significance was set at 0.05 used for all computations. Results were initially computed using all responses collectively in a series of generated frequency tables. Results were also examined by using a one-way ANOVA test when comparing school size and pre-activity stretching.

RESULTS

Demographics

There were fifty-six coach respondents, 23 males and 33 females, from Division I volleyball programs. The ages of the respondents in this study ranged from 24-65 (mean = 38.95 $\pm$ 7.77). The response rate was 19.4% and all non responders were sent a follow up email with a link to the survey. The respondents were a collection of head volleyball coaches, assistant volleyball coaches, strength and conditioning coaches, and assistant strength and conditioning coaches. Forty-eight respondents indicated they were the head volleyball coach, three were the assistant volleyball coach, two were the assistant strength and conditioning coach, one was the graduate assistant volleyball strength and conditioning coach, and one indicated he was the graduate assistant volleyball strength and conditioning coach, as well as graduate assistant volleyball coach (mean = 13.75 $\pm$ 7.63) (Table 1).

Years Coaching and Pre-Activity Responsibility

Included in the analysis was years coaching compared to pre-game and pre-practice protocols. The coaches were grouped in the following manner: 1 = 1-5 years coaching, 2 = 6-10 years, 3 = 11-15 years, 4 = 16-20 years, and 5 = 21+ years coaching. Group 1 results showed that the head coach was responsible for pre-practice activities 83.33% of the time and only 33.33% of the time prior to competition. Group 2 results showed that prior to practice, the head coach was responsible for the pre-activity flexibility 36.36% of the time prior to practice while only 30% of the time prior to

competition. Group 3 results indicate that the head coach was responsible for pre-practice flexibility 55.56% of the time and only 33.33% prior to competition. Coaches in group 4 (16-20 yrs) led pre-activity flexibility 20% of the time prior to practice and 0% prior to competition. The last group, group 5, consisting of coaches with 21 or more years of experience was responsible for the pre-practice flexibility at 14.29% and 0% prior to competition (Table 2).

The analysis also compared the individual responsible for conducting pre-activity flexibility prior to practice versus competition. The pre-activity flexibility conducted prior to practice was most commonly conducted by the head coach at 48%, followed by the assistant coach at 42%, head strength and conditioning coordinator 4%, and assistant strength and conditioning coordinator 6%. When dealing with pre-activity flexibility prior to competition, the head coach conducted the pre-activity flexibility only 20% of the time, the assistant coach 70%, head strength and conditioning coordinator 2%, assistant strength and conditioning coordinator 4%, and graduate assistant strength and conditioning coach 2% (Figure 1).

Current Pre-activity

Of the 56 respondents, 51 said that they have their athletes perform pre-activity flexibility (91.07%) compared to the 5 that do not require any type of general flexibility prior to activity (8.93%). Of the 56 respondents, 20 (41.67%) indicated that the pre-activity flexibility they used was sport specific -- such as slides, back pedal drills, etc. Twenty-eight (58.33%) indicated that their pre-activity flexibility involved sport specific

drills combined with jogging/form running. The remaining 8 respondents did not indicate their pre-activity flexibility preferences. All respondents who indicated they used static stretching pre-activity were head volleyball coaches. Table 3 indicates the specific type of stretching that is used prior to activity as indicated by the 91.07% (see Table 3).

Current Post- Activity

Of the respondents, 87.5% indicated that they require post-activity flexibility from their athletes. The 87.5% who indicated that they have athletes perform post-activity flexibility, had a break down as follows: 71.43% perform static stretching, 6.12% perform PNF stretching, and 22.45% perform a combination of static and dynamic stretching. None of the respondents had their athletes perform ballistic stretching or solely dynamic stretching (Table 4).

Program Funding and Pre-Activity Stretching

Schools were categorized according to their Division I football classification (BCS and Non-BCS) to see if financial resources had an impact on pre-activity stretching practices. BCS schools tend to have more money available for coaches' salaries and continuing education. Bowl Championship Schools (BCS) were members of the following conferences (Big East, ACC, SEC, Big Ten, Big Twelve and PAC Ten). Non-BCS or sometime called mid-major Universities were members of the following conferences (Atlantic 10, Big Sky, Big South, Big West Conference, Colonial Athletic, Great West Conference, Conference USA, Horizon League, Ivy League, Metro Atlantic

Conference, Mid-Eastern Conference, Mid-American Conference, Missouri Valley, Mountain West Conference, Northeast Conference, Patriot League, West Coast Conference, Western Athletic Conference, Southern Conference, Southland Conference, and Sun Belt Conference).

When comparing BCS schools to Non-BCS schools, results were examined to see if there were any differences or similarities in conducting pre-activity flexibility, specifically static stretching. Results based on a one-way ANOVA test, demonstrated no significant difference between the uses of pre-activity flexibility when comparing BCS schools to Non-BCS schools. With a 95% confidence interval (CI), Non-BCS schools performed pre-activity flexibility with static stretching between 33.3% -64.2%. BCS schools at a CI of 95% performing pre-activity flexibility with static stretching 0%-66% (small number of BCS schools responded). Because the CI overlaps the Non-BCS schools and the BCS schools, there is no definitive difference between the two groupings based on their affiliation of being a BCS or Non-BCS school and whether or not they perform pre-activity flexibility consisting of static stretching (Table 5). Part of the investigation also included if any of those programs participated in static stretching alone or combined with dynamic stretching to try and determine if BCS or Non-BCS schools were more likely to not follow current research that supports dynamic flexibility and no static stretching. Results indicated that out of the twenty-nine programs that stated they use static stretching or static combined with dynamic, six of them were BCS schools; the remaining twenty-three were all Non-BCS schools.

Pre-Activity Flexibility Practices and Overall W-L

Further research was conducted to see if those programs that performed static stretching prior to activity had adverse results on their win/loss record. The results show that eighteen of the twenty-nine (62%) programs had winning records while eleven of the schools (38%) had losing records. The results were not definitive that win/loss records would be adversely affected of all the programs that perform static stretching or static stretching in combination with dynamic stretching as part of the pre-activity routine. The results clearly show that the schools that perform static stretching as part of the pre-activity flexibility routine, the majority of them had winning records. Of the remaining programs, there were 21 that exclusively performed dynamic stretching as part of the pre-activity flexibility routine. Of the 21 programs, 10 had winning records (47%) while the remaining 11 (53%) had losing records. This too contradicts current research which indicates that dynamic stretching will help to better prepare the athlete for competition. The remaining 6 programs indicated that they do not require any type of pre-activity flexibility. Based on these results, it cannot be concluded that win/loss records are directly related to pre-activity flexibility practices when compared to current research regarding dynamic versus static stretching (Table 6).

Coaches Certification

The last area of examination was coaching certification. The most common type of volleyball specific coaching certification training is through USA Volleyball. USA volleyball offers several different levels of their coaching certification. The first level is

called Increased Mastery and Professional Application of Coaching Theory or IMPACT, which is an entry level certification which gives a broad base of knowledge from ethics to drill development specific to volleyball. The certification process than continues on with the Coaching Accreditation Program (CAP) which starts at level I and proceeds through level IV. Each level of the CAP certification is specific to the sport of volleyball and address separate issues at each level. Level I emphasizes teaching the skills of the game. Level II emphasizes organizing and developing team play. Level III emphasizes taking your team to the next level. Level IV is by appointment only and is usually reserved for those coaches who have coached for official USA National team or have assisted with a National or Olympic team. The final research question examined the impact of coaching certification and the use of pre-activity stretching specifically, static stretching. Out of 56 total respondents, there were 11 that indicated they had a coaching-specific certification and had their programs performing dynamic pre-activity flexibility prior to activity. Of the 56 respondents, 13 stated that they had a coaching specific certification and had their programs perform static stretching prior to activity; 16 stated they had no specific certification, but did have their athletes perform pre-activity static stretching. Of the remaining 16, 6 had no certification and did not require any type of stretch prior to activity and10 indicated they had no certification, but required dynamic flexibility prior to activity. Out of the 56 total respondents, more than half (52%) indicated they have a certification specific to volleyball. Of the 29 respondents with a specific volleyball coaching certification 6 were certified to the level of IMPACT, 12 were certified at the CAP I level, 3 were certified at the CAP II level, 6 were certified at CAP III level, none

were certified at the CAP IV level, and 2 had other specific coaching certifications not related to the USA volleyball certification process (1 is a Coaches Academy I and II graduate, the other has an SAQ certification). Out of those, only 36% of certified coaches have their athletes do dynamic flexibility, the remaining 64% have their athletes perform either no pre-activity flexibility or static stretching. There were 5 respondents that had a strength and conditioning certification (CSCS), 2 of the 5 were head volleyball coaches, 1 was the assistant strength and conditioning coach, 1 was the graduate assistant strength and conditioning coach as well as the graduate assistant coach, and the last was an assistant volleyball coach. Two of those 5 CSCS certified strength coaches had their programs take part in pre-activity static stretching by itself or in conjunction with dynamic stretching while the remaining 3 had their athletes perform dynamic stretching (Table 7). When comparing results for post-activity flexibility practices of the 29 coaches that indicated they had a volleyball specific coaching certification, 17 of them had their athletes perform static stretching, 2 did PNF, and 5 did a combination of dynamic and static stretching. While 17 (58%) of the coaches have their athletes perform static stretching as part of the post-activity flexibility routine , zero perform ballistic stretching, 2 have his or her athletes perform PNF stretching, zero perform dynamic stretching, and 5 has his or her athletes perform a combination of static and dynamic stretching.

DISCUSSION

Pre-activity/post-activity flexibility can have a profound influence on the athlete and their performance (Baechle and Earle, 2000; Fletcher and Anness, 2007; Mann and

Whedon, 2001; Swanson, 2006). Understanding the positive and negative effects of static, PNF, Ballistic, and dynamic stretching (Baechle and Earle, 2000; McMillian et al., 2006; Stone et al., 2006; Young and Elliott, 2001) performed pre- or post-activity and the use of a pre-activity warm-up (Faigenbaum et al., 2006; Herda et al., 2008; Kovacs, 2006; McMillian et al., 2006; Samuel et al., 2008; Yessis, 2006; Young and Elliott, 2001) is crucial for a coach to understand in order to optimize performance.

There were several interesting findings associated with the current study, specifically pre-activity versus post- activity flexibility, types of stretching used, who conducts pre- and post-activity stretching, the impact of coaching experience on pre-activity flexibility protocols, and comparing types of school (BCS / Non-BCS) and the type of pre-activity flexibility used. Based on the results, it is clear that the common trend in pre-activity flexibility in Division I volleyball programs is a combination sport-specific drills, as well as jogging/form running.

Pre-Activity vs. Post-Activity Flexibility

It is reasonable to conclude from the results that a majority of Division I Volleyball programs conduct pre-activity flexibility primarily consisting of dynamic stretching (86%). Of the 86% that perform dynamic stretching, twenty-eight of them combine static stretching with dynamic stretching. This is drastically different from the results of post-activity flexibility, with 87.5% of the respondents stating that they do require post-activity flexibility. Of that group, 71.4% indicate their post-activity flexibility routine involves static stretching with a significantly smaller percentage adding

in a dynamic stretch (22.45%) and 6.12% performing PNF stretching. It is clear that not all volleyball programs are in compliance with suggested current practices (Faigenbaum et al., 2006; Herda et al., 2008; Kovacs, 2006; McMillian et al., 2006; Samuel et al., 2008; Yessis, 2006) of having athletes perform dynamic flexibility versus using static stretching. Based on the results of the present study it is clear that not all of programs are in compliance with suggested current pre-activity flexibility practices (Faigenbaum et al., 2006; Herda et al., 2008; Kovacs, 2006; McMillian et al., 2006; Samuel et al., 2008; Yessis, 2006). As mentioned earlier in the results section, the demographic of respondents that does not follow the suggested recommendation was specifically head volleyball coaches of which some were also CSCS certified. In addition, it is also clear that although a majority of programs require a post-activity flexibility routine, there are still some programs that are not in compliance with post-activity flexibility recommendations of utilizing that time to perform static stretching (Stone et al., 2006; Kovacs, 2006). In the study conducted by Saez de Villarreal, Gonzalez-Badillo, and Izquierdo (2007) it was determined that high-intensity dynamic loading, as well as specific volleyball pre-activity protocol brought about the greatest effects on subsequent neuromuscular explosive response (Saez de Villarreal, Gonzalez-Badillo, and Izquierdo, 2007). The results of this survey are supported by the study conducted by Saez de Villarreal, Gonzalez-Badillo, and Izquierdo which supports that dynamic stretching is better for athletes pre-activity than static stretching.

Impact of Coaching Certification

When comparing coaching specific certification to pre-activity flexibility practices, it is again clear that not all coaches are in compliance with suggested pre-activity flexibility recommendations (Faigenbaum et al., 2006; Herda et al., 2008; Kovacs, 2006; McMillian et al., 2006; Samuel et al., 2008; Yessis, 2006). It is reasonable to say that coaching certification has no direct impact (based on results of this study) on pre-activity flexibility protocols. Out of the 56 respondents 29 have a volleyball specific coaching certification (just over slightly over 50%). It can be concluded that if you have a volleyball specific coaching certification, you are not more likely to omit static stretching from your pre-activity flexibility than someone who does not have a volleyball specific coaching certification. Based on these results it is clear that there needs to be some type of program set up for coaches to receive accreditation as a volleyball coach. In addition, all coaches should be required to receive continuing education units (CEU's) so that they stay current with pre- and post-activity flexibility protocols as well as other sport specific practices. While a small number of CSCS certified strength coaches responded to this survey, it can be determined from the results that again not all CSCS certified strength coaches are in compliance with suggested pre-activity flexibility practices. This is evidence in itself that this specific topic of pre-activity flexibility needs to be addressed more comprehensively in certification courses; including current research that talks about different types of flexibility practices and their importance. If an individual becomes a certified coach but does not use current practices or conducts pre-activity flexibility protocols improperly, potentially putting an athlete at risk, we should

then question the purpose even having a certification? In a similar study conducted by Judge, Craig, Baudendistal, & Bodey (2009), that examined pre-activity practices of football Division I and Division III football programs, revealed comparable results to this current study. It was determined that not all strength and conditioning coaches were in compliance with current pre-activity dynamic flexibility protocols. There were a number of strength coaches who appeared reluctant to discontinue traditional pre-activity methods such as static stretching even though the research indicated they should (Judge, Craig, Baudendistal, and Bodey, 2009). The study conducted by Judge, Craig, Baudendistal, and Bodey (2009) resulted in similar findings to the current study. Only 3% percent of the respondents that had their athletes perform pre-activity flexibility performed dynamic stretching exclusively (Judge, Craig, Baudendistal, and Bodey, 2009). Like the coaches from both Division I and III football programs in the study conducted by Judge, Craig, Baudendistal, and Bodey (2009), the volleyball coaches of the current study have not all discontinued the use of pre-activity flexibility that is not supported by current research. Current research indicates that PNF (if trained properly) and static stretching are the best choices for post-activity flexibility (Mann and Whedon, 2001) so again, not all coaches are adhering to current research trends.

Coaching Experience

There is also a correlation that suggests that as the years that a coach coaches increases, the likeliness that they will conduct the pre-activity flexibility routine decreases. This was evidenced in findings of this study when looking at how many years

a volleyball coach has coached versus who conducts the pre-activity flexibility routine. Coaches that have been coaching for twenty-one years or more were found to conduct pre-activity flexibility less than coaches of any other group with less years of experience. A total of 7 coaches fell into this category; out of those 7, less than half (3) had their athletes perform dynamic stretching as part of the pre-activity flexibility routine. The remaining 4 coaches had their athletes perform a combination of dynamic and static stretching as part of the pre-activity flexibility protocol. These findings are similar to the findings of the study conducted by Judge, Craig, Baudendistal, and Bodey (2009) indicating that the longer a coach has been coaching, the less likely he or she would be in compliance with current suggested practices of performing dynamic flexibility prior to activity. Much of the current research on this topic has been within the last 10-20 years thus indicating that the coaches may have developed their training habits prior to the research being conducted. While reviewing the results, there was also evidence that the head coach does less with the pre-activity routine prior to competition versus practice. It can be reasonably assumed that it is due to other pre-game related duties. These results support the previous data indicating that for unknown reasons, coaches tend to be less involved in the pre-activity routine prior to games than in practices. This data compared to the data regarding the type of pre-activity flexibility performed, appears to show significant correlation between the years of coaching and pre-activity flexibility protocols.

BCS versus Non-BCS Programs

When comparing BCS schools and Non-BCS schools to determine if there were significant differences in the use or type of pre-activity flexibility used, the results proved to be quite clear. Due to an overlapping confidence interval, it would be reasonable to say that there is no obvious difference between the type of school (BCS / Non-BCS) and whether or not they perform pre-activity flexibility. The results show that you are not more likely to do pre-activity flexibility consisting solely of dynamic stretching if you are a BCS school or a Non-BCS school. Of the BCS schools that participated in the study, 60% used static stretching as part of the pre-activity flexibility routine and 40% used only dynamic stretching. Of the Non-BCS school, 63% used static stretching as part of the pre-activity flexibility routine and 39% used only dynamic stretching. This indicates that whether you are from a BCS or Non-BCS school, you are more than likely to not follow current suggested pre-activity flexibility protocols which were congruent with the study conducted by Judge, Craig, Baudendistal, and Bodey (2009) that indicated coaches from both Division I and Division III programs also were more likely to conduct pre-activity flexibility consisting of static stretching. In fact, you are more likely to go against suggested pre-activity flexibility practices (Faigenbaum et al., 2006; Herda et al., 2008; Kovacs, 2006; McMillian et al., 2006; Samuel et al., 2008; Yessis, 2006) if you are from both a BCS and Non-BCS school. Further research drew inconclusive results when comparing win/loss record with static stretching prior to activity.

Although this study has a relatively small subject pool, the data collected from it is of value. There is clear indication that the majority of Division I programs from both

BCS and Mid Major schools see the value of using dynamic flexibility as part of their pre-activity protocol, as well as static stretching post activity to help prevent injury. It is also clear that not all programs see the benefits of dynamic flexibility, instead electing to still use static stretching prior to activity. In addition, there are still programs that do not utilize post-activity time to for proper post-activity flexibility to help reduce the risk of injury and help to gain significant range of motion (Mann and Whedon, 2001).

PRACTICAL APPLICATIONS

This study indicates that it is important for all coaches, specifically head volleyball coaches, to understand the benefits of pre-activity flexibility (dynamic in nature) and the benefits of post-activity flexibility (static in nature) for their programs (Faigenbaum et al., 2006; Herda et al., 2008; Kovacs, 2006; McMillian et al., 2006; Samuel et al., 2008; Young and Elliott, 2001). It is evident that some coaches, volleyball and strength coaches are unwilling or reluctant to part with traditional methods of static stretching prior to activity (Bandy and Irion, 1994; Swanson, 2006). It would be of value for head volleyball coaches to partake in a recertification course that includes current research trends in a way that positively impacts their coaching futures. Being well educated on current research will help the athletes to be better prepared for competition and to help maximize their volleyball performance. The findings of this study can have a profound impact on the sport of volleyball. Understanding the benefits of pre-activity dynamic stretching, post-activity cool downs, and post-activity stretching can allow a coach to conduct all aspects of a practice and game preparation in line with current research. This will in turn lead to better preparation and possibly less incidence of injury.

All coaches should be required to take initial certification classes that discuss current practices for pre- and post-activity flexibility. In addition to these initial requirements, the coach should also stay current with ever-changing trends by attending clinics specific to their sport (continuing education units), as well as annually meeting with a certified athletic trainer or attending a conference that focuses on current suggested protocols for pre- and post-activity flexibility. It is often difficult for older coaches to break old habits, but staying current with new trends and methods can have a positive effect on athletes and their performance. There should also be nationwide certification process for anyone who wants to coach at any level; this could be the first step to get all coaches on the same page and to understand the importance of a pre-activity dynamic flexibility.

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Appendix A

Table A1.

Respondents' Demographics

Topic	Mean	Standard Deviation
Age	38.95	7.77
Coaching Experience	13.75	7.63

Table A2.

Pre-activity Warm-up/Stretching and Coaching Experience

Group	Pre-Practice (Coach Lead)	Pre-Game (Coach Lead)
1 (1-5 yrs)	83.33 %	33.33 %
2 (6-10 yrs)	36.36 %	30 %
3 (11-15 yrs)	55.56 %	33.33 %
4 (16-20 yrs)	20 %	0 %
5 (21 + yrs)	14.29%	0%

Table A3.

Pre-activity Stretching used by Coaches

Type of Pre-Activity Flexibility	**Count**	**Percent**
Static Stretching	7	14 %
Ballistic Stretching	0	0 %
PNF Stretching	0	0 %
Dynamic Stretching	21	42 %
Combination of Static and Dynamic Stretching	22	44 %

Table A4.

Post-Activity Stretching used by Coaches

Type of Post-Activity Flexibility	**Count**	**Percent**
Static Stretching	35	71.43 %
Ballistic Stretching	0	0 %
PNF Stretching	3	6.12 %
Dynamic Stretching	0	0 %
Combination of Static and Dynamic Stretching	11	22.45 %

Table A5.

Pre-Activity Stretching Practices of BCS versus Non-BCS Schools

	BCS School 10 Respondents	NON-BCS School 40 Respondents	Percentage of BCS/Non-BCS Performing Specific Flexibility Pre-Activity
Static Stretching	1	6	10% / 14%
Ballistic Stretching	0	0	0% / 0%
PNF Stretching	0	0	0% / 0%
Dynamic Stretching	4	17	40% / 43%
Combination of Static and Dynamic Stretching	5	17	50% / 43%

- 6 Non-BCS schools indicated they did not perform any type of pre-activity flexibility

Table A6.

Pre-Activity Stretching Routine and W-L Record

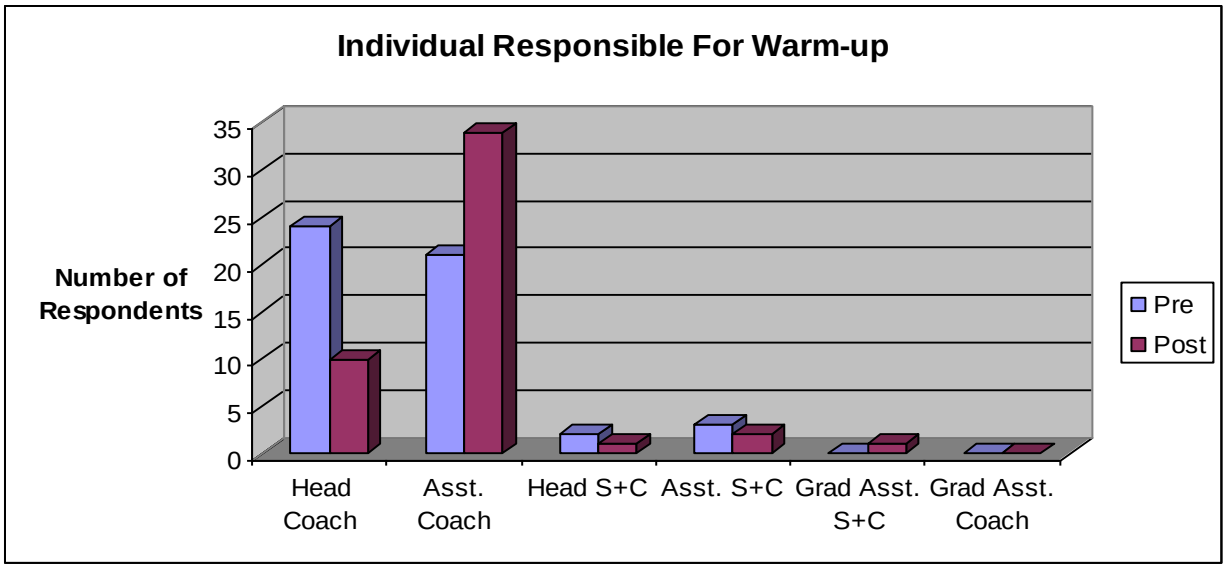
	Static Stretch	Ballistic Stretch	PNF Stretch	Dynamic Stretch	Combination of Static and Dynamic Stretch
Teams with a season winning record	4	0	0	10	14
Teams with a season losing record	3	0	0	11	8

Table A7.

Coaching Certification and Pre-Activity Stretching

Certification	Dynamic Stretch Pre-Activity	Static Stretch Pre-Activity	Ballistic Stretch Pre-Activity	PNF Stretch Pre-Activity	Combination Static/Dynamic Stretch Pre-Activity	No Stretch Pre-Activity
Certified Coach	19.64%	23.21%	0%	0%	0%	10.71 %
Non-Certified Coach	17.85%	17.85%	0%	0%	0%	0%

Figure A1.


Individual Responsible For Warm-up
Number of Respondents
35
30
25
20
15
10
5
0
Head Coach
Asst. Coach
Head S+C
Asst. S+C
Grad Asst. S+C
Grad Asst. Coach
Pre
Post